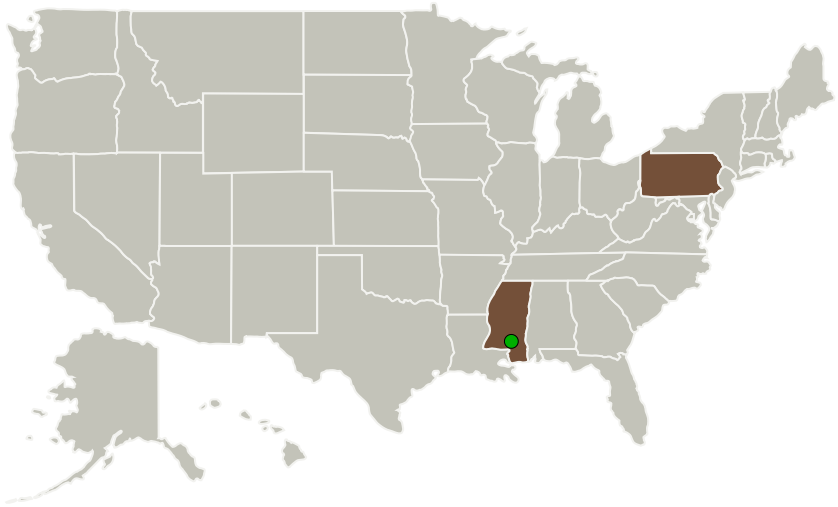
Cryogenic Clamp-on Ultrasonic Flowmeters using Single Crystal Piezoelectric Transducers, Phase I

Completed Technology Project (2010 - 2010)

Project Introduction

Clamp-on ultrasound cryogenic flowmeters using single crystal piezoelectric transducers are proposed to enable reliable, accurate cryogenic instrumentation needs in support of NASA Lunar Lander, Ground Operations, Altair, Ares, and Lunar Surface Systems programs. In-space, on the lunar surface, and on the Earth Exploration Systems architecture presents cryogenic storage, distribution, and fluid handling challenges that require new technologies to be developed. Clamp-on ultrasonic flowmeters are proposed because of their advantages such as high turn-down ratio, non-intrusive, no pressure drop, bi-directional measurement, no moving parts and fast response. Single crystal piezoelectrics are attractive because they exhibit 3 to 5 times the strain as conventional piezoelectric ceramics, and retain excellent piezoelectric performance at cryogenic temperatures (< 20 K). Cryogenic piezoelectric transducers with broad bandwidth and high sensitivity will be designed, fabricated and characterized, and cryogenic gas flow rate measurements will be performed using the developed cryogenic transducers. It is expected to have 10-20 dB sensitivity gain (combining transmitting and receiving) for clamp-on ultrasonic flowmeters by using novel single crystal piezoelectric transducers.

Primary U.S. Work Locations and Key Partners



Cryogenic Clamp-on Ultrasonic Flowmeters using Single Crystal Piezoelectric Transducers, Phase I

Table of Contents

Cryogenic Clamp-on Ultrasonic Flowmeters using Single Crystal Piezoelectric Transducers, Phase I

Completed Technology Project (2010 - 2010)

Organizations Performing Work	Role	Type	Location
TRS Ceramics, Inc.	Lead Organization	Industry	State College, Pennsylvania
Stennis Space Center(SSC)	Supporting Organization	NASA Center	Stennis Space Center, Mississippi

Primary U.S. Work Locations	
Mississippi	Pennsylvania

Project Transitions

January 2010: Project Start

July 2010: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/138907)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

TRS Ceramics, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

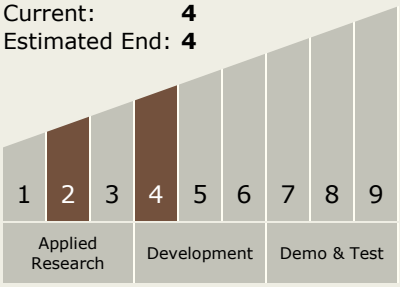
Carlos Torrez

Principal Investigator:

Xiaoning Jiang

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



Cryogenic Clamp-on Ultrasonic Flowmeters using Single Crystal Piezoelectric Transducers, Phase I

Completed Technology Project (2010 - 2010)

Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.1 Chemical Space Propulsion
    - TX01.1.3 Cryogenic

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System